General Motors
North America Product Development
Vehicle Integration
Robert C. Lange, Executive Director
Safety Integration

USG 3646
December 20, 2001

The Honorable Jeffrey Runge
Administrator
National Highway Traffic Safety Administration
400 Seventh Street, S.W., Room 5220
Washington, D.C. 20590

Subject: Daytime Running Lamps

Dear Dr. Runge:

General Motors Corporation petitions the National Highway Traffic Safety Administration (NHTSA) to amend FMVSS 108 – Lamps, Reflective Devices and Associated Equipment – to require the installation of daytime running lamps (DRLs) on passenger cars, multipurpose passenger vehicles, trucks and buses that have a gross vehicle weight rating under 4,536 kilograms. The safety benefits of DRLs justify rulemaking to require the installation of these lamps as standard equipment on light-duty motor vehicles.

In November of 1990, GM petitioned the agency to amend FMVSS 108 to allow the optional installation of these DRLs (Mr. Robert Rogers' letter to Mr. Barry Felrice, USG 2844, dated November 19, 1990). This rulemaking was required to provide federal preemption of various state laws that had the unintended consequence of prohibiting the use of DRLs. The NHTSA issued a final rule responsive to the GM petition (Docket No. 87-6, Notice 5 published in the Federal Register on January 11, 1993). GM began the voluntary phase-in of DRLs on 1995 model-year vehicles and completed its phase-in program in the 1997 model year. Since the 1997 model year, DRLs have been standard equipment on virtually all GM light duty vehicles sold in North America and to date approximately 25 million GM vehicles equipped with DRLs have been sold in the United States. Several other vehicle manufacturers now also offer DRLs including: BMW, Ford (fleet customers), Isuzu, Mercedes-Benz, Saab (now part of GM), Subaru, Suzuki, Toyota, Volkswagen, and Volvo.

The increasing acceptance of DRLs is coincident with a growing body of evidence that these devices are reducing crashes. The field effectiveness of DRLs has been demonstrated repeatedly and conclusively, as discussed below:

- Numerous studies conducted in Sweden, Norway, Finland, Denmark, Hungary, Canada, and the U.S. have evaluated the field effectiveness of DRLs, and all of them have found DRLs to be associated with reduced crashes. The degree of effectiveness in reducing DRL-relevant crashes has generally ranged from 5% to more than 30%. A 1994 Transport Canada study found that DRLs reduced relevant daytime multiple-vehicle crashes in Canada by 11%. A follow-up study by Transport Canada published in March of 1996 found that DRLs reduced multiple-vehicle crashes by 9.2% during daytime hours, and 16.5% during twilight. While several DRL effectiveness studies were completed prior to the 1990's, General Motors' 1990 petition requested that FMVSS 108 be amended to allow for optional, rather than mandatory installation of DRLs. At that time it was not clear that DRLs would be as effective in the U.S. as they had shown themselves to be in other countries. Since then, studies have affirmed the effectiveness of DRLs in the U.S.

- A 1985 study by the Insurance Institute for Highway Safety (IIHS) concluded that commercial fleet passenger vehicles modified to operate with DRLs were involved in 7% fewer daytime multiple-vehicle crashes than are similar vehicles without DRLs. A 2000 IIHS study found DRLs to be associated with a 3% decline in daytime multiple-vehicle crashes in 9 U.S. states. Since daytime multiple-vehicle crashes account for about half of all police-reported crashes, even this low-end estimate of 3% effectiveness would result in an anticipated 100,000 multiple-vehicle crashes avoided annually if all light duty vehicles in the U.S. fleet were equipped with DRLs.

- In February of 2000, NHTSA published a technical report entitled 'A Preliminary Assessment of the Crash-Reducing Effectiveness of Passenger Car Daytime Running Lamps' (DOT HS 808 645). The agency evaluated DRL effectiveness for three daytime crash types in the United States – fatal single-vehicle pedestrian crashes, non-fatal two-vehicle crashes, and fatal two-vehicle crashes. The study found DRLs to be associated with a statistically significant 28% reduction in fatal single-vehicle pedestrian crashes. (This powerful influence of DRLs in reducing pedestrian crashes has prompted European regulators to consider relaxing the pedestrian protection requirements for vehicles equipped with DRLs.) The other statistically significant finding of NHTSA's study was a 7% reduction in non-fatal two-vehicle crashes.

- General Motors commissioned an independent study to evaluate the effectiveness of DRLs in the U.S. Exponent Failure Analysis Associates compared the collision rates of specific GM, Volvo, Saab and Volkswagen vehicles before and after the introduction of daytime running lamps. Using police accident reports from 12 states and R.L. Polk vehicle registration data, the research found that the reduction of DRL-relevant crashes was in excess of 5%, and the reduction of urban vehicle-to-pedestrian crashes was approximately 9%. Based on these findings, GM estimated that its customers had avoided more than 17,000 crashes as a result of DRLs (see attached GM press release issued in April of 2000). With the additional time elapsed since the GM press release, and the additional fleet population of DRL-equipped vehicles, the current total of crashes avoided by GM customers is over 25,000. [Daytime Running Lamps (DRLs) – A North American Success Story, Peter Bergkvist, 17th International Conference on Enhanced Safety of Vehicles (ESV), June 2001, Paper 395.)

The evidence demonstrates that DRLs are preventing crashes and injuries, and saving lives. The installation of DRLs on all light-duty vehicles would expand these benefits across the entire new light duty vehicle fleet. The significant safety benefits of DRLs, combined with their modest cost, make DRLs one of the most cost-effective crash avoidance opportunities available today.

The potential safety benefits of DRLs can be gained by maintaining DRL intensity requirements at a level that will not compromise their effectiveness, and by requiring their installation on all light-duty vehicles sold in this country. GM encourages the agency to move expeditiously to begin rulemaking to realize these safety benefits. If you have questions regarding this petition for rulemaking, please contact Phil Horton (810-947-1738), Steve Gehring of our Washington office (202-775-5071), or me (810-986-8764).

Sincerely,

Robert C. Lange, Executive Director
Structure & Safety Integration

cc: Mr. Richard VanIderstine

Attachment

April 28, 2000

Study: 17,000 Vehicle Crashes That Never Happened

Daytime Running Lamps Proven Effective in Avoiding Crashes

NEW YORK - General Motors Corp. today announced results of an independent study concluding that GM customers have avoided more than 17,000 vehicle crashes -- representing more than a 5 percent reduction in daytime, multi-vehicle, non-rear-end collisions -- since GM began equipping vehicles with daytime running lamps in 1995. As the name suggests, this safety feature increases a vehicle's visibility by illuminating lamps on the front of the vehicle whenever the headlamps are not turned on.

Using data from Scandinavian countries where daytime running lamps were mandatory, GM petitioned the National Highway Traffic Safety Administration in 1990 to allow automakers to install the feature voluntarily. Once NHTSA allowed daytime running lamps in 1993, GM began installing them. By the 1997 model year, all GM cars and trucks sold in the United States had daytime running lamps. To date, GM has sold more than 20 million vehicles in the United States equipped with daytime running lamps as standard equipment.

The study, conducted by Exponent Failure Analysis Associates of San Francisco, compared the collision rates of specific GM, Volvo, Saab and Volkswagen vehicles before and immediately after the introduction of daytime running lamps. Using information from police accident reports and R. L. Polk registration data from 12 states, the study concluded that the reduction of relevant crashes was in excess of 5 percent, and the reduction in urban vehicle-to-pedestrian crashes was approximately 9 percent.

The measurable safety benefits of daytime running lamps are reinforced by real world traffic safety statistics: 71 percent of all vehicle crashes involve two or more vehicles; 59 percent of multi-vehicle crashes are non-rear end collisions; and 74 percent of all crashes occur during daylight, dawn or dusk.

"When it comes to safety engineering, improvements are generally measured in fractions, so we are delighted to learn that daytime running lamps have resulted in a full 5 percent reduction in certain collisions," said Bob Lange, engineering director for GM's Safety Center. "By definition, all of the relevant crashes involved more than one vehicle. That means that at least 34,000 drivers (at least half of which were in vehicles equipped with daytime running lamps) - and all of their passengers -- were not subject to the frustration, inconvenience and expense, or to the potential pain, that are often the unfortunate byproducts of being involved in a crash. We find that extremely gratifying."

Automotive safety authorities agree that a vehicle's driver is the most significant influence on collision involvement. Making vehicles more conspicuous to oncoming drivers through the use of daytime running lamps has provided the highest product benefit that GM has been able to quantify in helping to reduce crash involvement. This same benefit is recognized in other areas, such as the motorcycle and aircraft industry, where it becomes exceedingly important to identify the vehicle against its background.

Scientific studies have clearly shown that the human eye will be able to recognize an object against its background when lighted in this manner. Scientific studies also demonstrate that oncoming drivers suffer no disabling glare at the levels of light intensity in these vehicles.

General Motors (NYSE: GM), the world's largest vehicle manufacturer and long a leader in safety engineering, designs, builds and markets cars and trucks worldwide. In 1999, GM earned $5.6 billion on sales of $176.6 billion. It employs about 388,000 people globally.

GM is investing aggressively in high technology and e-business within its global automotive operations and through such initiatives as e-GM, GM BuyPower, OnStar and its Hughes Electronics Corp. (NYSE: GMH) subsidiary.

GM also operates one of the world's largest and most successful financial institutions, GMAC. More information on General Motors can be found at www.gm.com. # # #

DAYTIME RUNNING LIGHTS (DRLs) - A NORTH AMERICAN SUCCESS STORY.

PETER BERGKVIST
GENERAL MOTORS CORPORATION
UNITED STATES OF AMERICA
PAPER 395

ABSTRACT

Many traffic collisions are the result of the driver's failure to notice the other vehicle. It is often cited in police reports that the driver "looked but did not see". The purpose of Daytime Running Lights (DRLs) is to increase the visual contrast of DRL-equipped vehicles. Visual contrast, which is the difference in brightness between two areas, is an important characteristic enabling a driver to detect objects. This paper begins with a brief regulatory history of DRLs in the U.S. and how General Motors Corporation (GM) introduced DRL-equipped vehicles. It also describes a DRL effectiveness study conducted by Exponent Failure Analysis Associates of San Francisco for GM.
The study compared the collision rates of specific GM, Saab, Volvo and Volkswagen vehicles before and immediately after the introduction of DRLs. Since DRLs are not visible from behind a vehicle, rear-end collisions were not included in the study. Information from police accident reports and registration data shows that GM customers have avoided more than 25,000 vehicle collisions since GM began equipping vehicles with DRLs in 1995.

INTRODUCTION

Motor vehicles are equipped with lights not only for seeing but also for being seen. During daytime conditions, DRLs make a vehicle more conspicuous and enable others to observe a vehicle sooner, and thus possibly avoid a collision. This is especially true when ambient illumination is low, such as during dusk, dawn, rain and overcast conditions; or when there is little contrast between the vehicle and that of it's background, such as a green car against foliage or a light car against snow. Vehicle conspicuity is also influenced by the age of the observer, since visual acuity declines with age. As the average age of the U.S. driving population continues to increase, vehicle conspicuity may become more important.

Collision reductions associated with DRLs were reported as early as 1964 in studies of US companies that used DRLs on their fleets. Examples of such early DRL users are Greyhound Bus Company and Chicago's Checker Cab Company. In early 1960 a campaign in Texas entitled "Drive Lighted and Live" urged Texas drivers to use their headlights during major holidays. A study was also done by the New York Port Authority (Cantilli, Traffic Engineering, 1969) where 200 vehicles operated by the Port Authority were modified so that the parking lights and tail lights were illuminated automatically when the vehicle was started. A variety of vehicle models were included in this study. For a year, beginning in July 1967, accidents involving these vehicles were monitored along with those of a control group of about 400 unmodified vehicles. The group of modified vehicles were involved in 18% fewer collisions than the unmodified vehicles. In addition, the modified vehicles were involved in less severe collisions. When passenger vehicles only were considered, the modification lowered the collision rate by 23%.

The Scandinavian countries were the first to make DRLs mandatory for all vehicle users. Seven countries in the world currently require DRLs. Following are the seven countries and the year in which DRLs became mandatory:

- Finland (1972, rural roads during wintertime)
- Sweden (1977)
- Norway (1985)
- Iceland (1988)
- Canada (1989)
- Denmark (1990)
- Hungary (1993)

Effectiveness studies conducted in Finland and Sweden during the 1970's are particularly interesting since they evaluated entire vehicle fleets. In Finland, rural multiple-vehicle accidents decreased by 27% after DRLs were mandated. In Sweden an 11% reduction in daytime collisions was observed. Two-vehicle head-on collisions were reduced by 10%, angle crashes were reduced 9% and collisions involving cyclists and mopedists were reduced by 21%. Collisions involving pedestrians were reduced by 17%. Figure 1 shows a summary of DRL field effectiveness studies:

Year	Investigator (s)	Study Type	Country	Estimated Effects
1964	Allen and Clark[1]	Fleet	U.S.	7.2% to 38% crash reduction
1972	Anderson et al[2]	Law	Finland	27% reduction rural multi-vehicle
1975	Attwood[3]	Fleet	Canada	20% some defense vehicles
1977	Anderson et al[4]	Law	Sweden	9% to 21% - crash type dependant
1985	Stein[5]	Fleet	U.S.	7% reduction selected vehicles
1988	Elvik[6]	Law	Norway	15% reduction summer multi-vehicle
1993	Arora et al[7]	Law	Canada	11.3% reduction 2 vehicle different direction
1993	Hansen[8]	Law	Denmark	Up to 37% reduction – crash type dependant
1995	Hollo[9]	Law	Hungary	7% to 14% reduction frontal cross traffic
1997	Tofflemire et al[10]	Law	Canada	5.3% reduction, opposite direction/angle

Figure 1.
Summary of Field Effectiveness Studies.

In early 1987, the National Highway Traffic Safety Administration (NHTSA) proposed to permit the installation of DRLs. The rulemaking was terminated in June 1988 because the majority of commenters opposed the proposal and a national safety need had not been identified.

In November 1990, based on effectiveness data from the Scandinavian countries, GM petitioned NHTSA to allow the optional use of DRLs.
A final rule was published in January 1993 amending Federal Motor Vehicle Safety Standard (FMVSS) 108 to explicitly allow the voluntary installation of DRLs. This rulemaking was needed because a multitude of conflicting state laws had the practical effect of prohibiting the installation of DRLs.

GM began to install DRLs on selected 1995 model year vehicles. By the 1997 model year, DRLs were standard equipment on all GM vehicles sold in the U.S. To date, GM has sold more than 23 million vehicles in the U.S. equipped with DRLs. GM, Saab, Volvo and Volkswagen were the first manufacturers to introduce DRLs in the U.S.

DRLs are provided in a variety of configurations. These include reduced intensity upper beams, reduced or full intensity low beams, dedicated DRLs, or turn signal DRLs. A Notice of Proposed Rule Making (NPRM) was issued by NHTSA in August 1998 intended to address glare. NHTSA explained that the proposal to limit DRL photometric output was prompted by numerous driver complaints regarding DRL glare.

NHTSA planned to address glare according to the following plan:

Phase 1 – DRLs utilizing the upper headlamp beam would not be permitted to exceed 3,000 cd at any point. Starting one year after publication of the final rule.

Phase 2 – Reduce the intensity to 3000 cd anywhere in the beam and for lower beam DRLs to maximum 3000 above horizontal. Starting two years after publication of the final rule.

Phase 3 – Reduce the intensity to 1500 cd anywhere in the beam and for lower beam DRLs to maximum 1500 cd above horizontal. Starting four years after publication of the final rule.

An analysis of the complaints that NHTSA had received revealed that the number of complaints were overestimated because of repeats and multiple copies of letters. Some complaints were solicited by organizations who opposed DRLs in principle. When the solicited and redundant comments were removed, the actual number of unsolicited complaints fell dramatically.
In Canada where DRLs have been mandatory since 1989, the few initial DRL complaints dropped to virtually zero by the early 1990's. Canadian complaints continue to be virtually non-existent even though they have the same photometric provisions as those specified in the current U.S. FMVSS 108. Other countries, where DRLs are mandatory, have shown the same pattern as Canada.

This suggests that perceived glare may be a novelty effect.

Accordingly, GM is hopeful that NHTSA does not adopt the DRL photometric restrictions proposed in the NPRM. The proposed revisions would likely reduce the effectiveness of DRLs, preclude the use of head lamp DRLs, and undermine DRL harmonization.

GM believes there is a strong general acceptance of DRLs in the market place. The following two charts are the results of surveys conducted to determine the consumers perception of DRLs as a safety feature. These surveys clearly show that DRLs are viewed as a safety enhancement.

Opinion of DRLs	Percentage
Beneficial feature	64
Neutral Feature	26
Negative Feature	8
No Response Given	2

Figure 2.
Market Acceptance of DRLs
Source: Voice of the Public (6/23/98)

Safety Feature	Definitely Wants
Anti-Lock Brake System	59%
"Smart" Airbags	32%
Daytime Running Lamps	23%
Electronic Traction Control	18%
Side Impact Airbags	18%
Rear Passenger Airbags	10%
Run-flat Tires	10%
Navigation Systems	9%
Auto 911 Dialing	7%

Figure 3.
Safety Features Wanted
Source: J.D. Power & Associates, 1997

GM FIELD EFFECTIVENESS STUDY

Analysis. The study to assess DRL effectiveness was conducted by Exponent Failure Analysis Associates of San Francisco and compared the accident rates of certain GM, Saab, Volvo and Volkswagen passenger cars prior to and immediately after the introduction of DRLs. The following collision types were examined in the study:

- Daytime Multiple Vehicle Collisions
- Daytime Head-On Collisions
- Daytime (Foggy, Cloudy and Rainy Conditions)
- Multiple Vehicle Collisions During Dusk or Dawn Hours
- Daytime Multiple Vehicle Turning/Angle Collisions
- Daytime Multiple Vehicle Side Collisions
- Daytime Multiple Vehicle Collisions in Urban Areas
- Daytime Multiple Vehicle Collisions in Rural Areas
- Daytime Collision with Pedestrian in Urban Areas
- Multiple Vehicle Night-time Collisions

Since DRLs are not visible from behind a vehicle, rear end collisions are not influenced by the presence of DRLs, and they were not included in the study.

Crash rates were calculated in terms of collisions per 10,000 vehicle years of exposure. To estimate the effect of DRLs, the collision rates were modeled by a Poisson regression model with the presence or absence of DRLs as one of the factors in predicting the resulting collision rates. Other factors in the regression model include the state from which the data were drawn and the types of vehicles involved. The following equations were used:

$$\text{Collision Rate} = \frac{\text{No. of Collisions}}{\text{No. of Vehicles} - \text{Years of Use}}$$

$$\text{Rate Ratio} = \frac{\text{Collision Rate (with DRL)}}{\text{Collision Rate (without DRL)}}$$

Overall Odds Ratio: Estimated by Poisson Regression (combining results across states, models)

Data Sources. Over 100,000 collisions were examined in this analysis. The crash records were drawn from police reported traffic crash data from the following 12 states, totaling more than 5 million vehicle years of exposure:

- Alabama
- Arkansas
- Florida
- Georgia
- Idaho
- Iowa
- Maryland
- Missouri
- North Carolina

- Pennsylvania
- Texas
- Washington

For each state, crash data from 1994 to 1997 were used except for Pennsylvania and Arkansas. The 1997 data for these two states were omitted due to the absence of sufficient VIN data.

In addition to collision data, vehicle exposure data were calculated from R.L. Polk vehicle registration data. In order to maximize the useable collision data, monthly vehicle registration data, instead of the annual registration, for these vehicles were used.

Results. The field effectiveness of DRLs was estimated through use of the coefficient associated with the DRL factor in the regression model. The coefficient can be interpreted as the ratio (relative risk or odds ratio) of the crash rate among vehicles with DRLs to the crash rate among vehicles without DRLs. A ratio less than 1.0 would suggest that vehicles with DRLs have a lower crash rate than those without DRLs. A ratio larger than 1.0 would suggest the converse. Since the frequency of collisions is subject to random fluctuations (in driving conditions, driver factors, vehicle factors, etc) a 95% confidence interval for this ratio is also estimated. A summary of the results are shown below:

Accident Type	Relative Risk	95% Confidence Interval
Daytime Multiple Vehicle Collisions	0.89	0.86-0.93
Daytime Head-On Collisions	0.87	0.81-0.93
Daytime Multiple Vehicle Angle/Turning	0.87	0.84-0.91
Daytime Multiple Vehicle Side Collisions	0.86	0.82-0.90
Daytime Multiple Vehicle Collisions in Cloudy, Foggy, Rainy Days	0.88	0.84-0.92
Multiple Vehicle Collisions During Dusk or Dawn	0.91	0.84-0.99
Daytime Multiple Vehicle Collisions in Urban Area	0.88	0.84-0.92
Daytime Multiple Vehicle Collisions in Rural Area	0.95	0.90-1.00
Daytime Collision with Pedestrian in Urban Area	0.88	0.79-0.97
Multiple vehicle Collisions at Nighttime	0.95	0.90-<1.0

Figure 4.
Summary of the Field Effectiveness Study

In all collision types except for daytime multiple-vehicles collisions in rural areas, the 95% confidence intervals show that the reduction in crash rates is statistically significant. That is, the observed degree of crash reduction is highly unlikely to be the result of chance variation in the data. The results observed would occur by chance no more than 5% of the times if there were truly no reduction in crash rates due to DRLs. The crash distribution was examined in general and it was found that about 80% of all crashes occur during daytime where DRLs are effective. During nighttime hours drivers would be expected to use their regular headlamps, and DRLs would not be in operation. However, since most DRL systems are designed to operate automatically, this may help certain operators who may not remember to turn on their regular headlamps in low ambient light conditions. The reduction in nighttime collision rates may be an unanticipated beneficial side effect of automated DRLs. Preliminary analysis of the hour when collisions occurred showed that a greater proportion of the nighttime reduction came from the early evening hours.

SUMMARY AND CONCLUSIONS

Past DRL effectiveness studies have shown DRLs to be effective in reducing crashes. The recent GM/Exponent study has confirmed this finding for vehicles in the U.S. fleet. Our study shows:

- a reduction in relevant multiple-vehicle crashes in excess of 5%, and

- a reduction in urban vehicle-to-pedestrian collisions of approximately 9%.

The results of this study indicate that GM customers have avoided more than 25,000 daytime, multiple-vehicle, non-rear-end collisions since DRLs were introduced.
By definition, all of the relevant 25,000 collisions involved more than one vehicle. This means that at least 50,000 drivers and all of their passengers were not subject to the frustration, inconvenience and expense, or to potential pain and injury resulting from these collisions. Modern improvements in automotive safety are typically measured in small increments. It is gratifying to see preliminary DRL effectiveness estimate in certain collision types in excess of 5%.

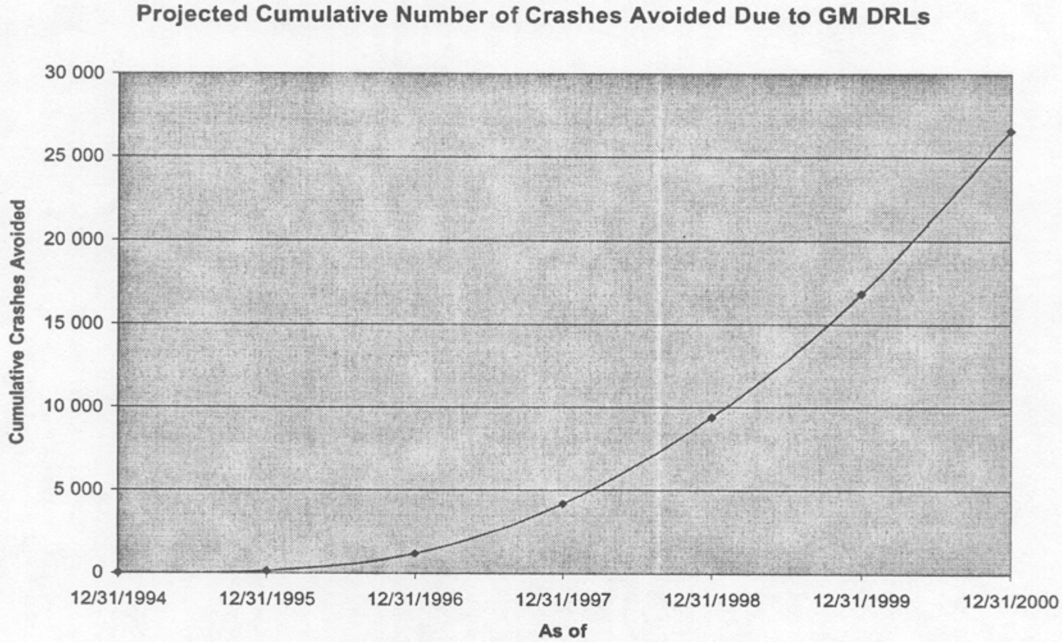

Figure 5
Projected Cumulative Number of Collisions Avoided Due to GM DRLs.

Furthermore the measurable safety benefits of DRLs are reinforced by real world traffic safety statistics: 71% of all vehicle crashes involve two or more vehicles, 59% of multiple-vehicle collisions are non-rear end and 74% of all collisions occur during daylight, dawn or dusk.

Worth mentioning is NHTSA's own DRL effectiveness study, "A Preliminary Assessment of the Crash-Reducing Effectiveness of Passenger Car Daytime Running Lamps (DRLs)" , Technical Report DOT HS 808 645 where they show that DRLs reduce daytime fatal single vehicle pedestrian deaths by 28 to 29% and non-fatal two vehicle crashes by 5 to 7% depending on statistical technique used.

GM considers DRLs to be among the most significant crash avoidance advancements since the adoption of Federal Motor Vehicle Safety Standard (FMVSS) 108 –Lamps, Reflective Devices, and Associated Equipment. Previously, Center High Mounted Stop Lamps were considered to be the most significant advancement in reduction of relevant collisions, DRLs appear more effective in reducing relevant collisions. DRL collisions are also some of the most severe:

- Head-On collisions
- Intersection collisions.

GM is pleased to be among the first manufacturers to provide DRLs as standard equipment across it's U.S. fleet.

ACKNOWLEDGMENT

I would like to thank Edmund Lau at Exponent Failure Analysis Associates of San Francisco and Joseph P. Lavelle at General Motors, North American Technical Center for their assistance in creating this paper.

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